Experimental bifurcation by using control-based continuation

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Experimental bifurcation analysis by using control-based continuation

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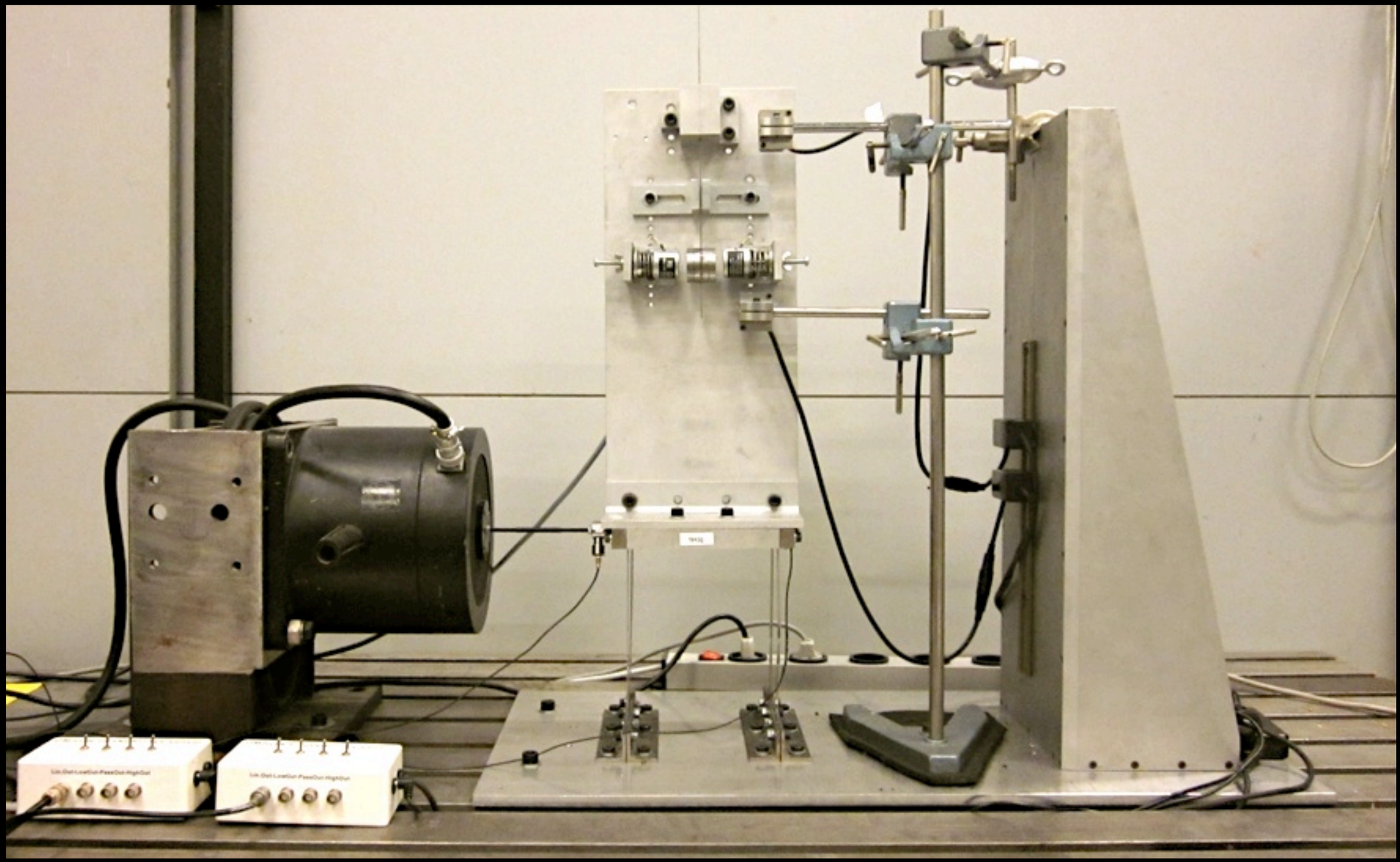
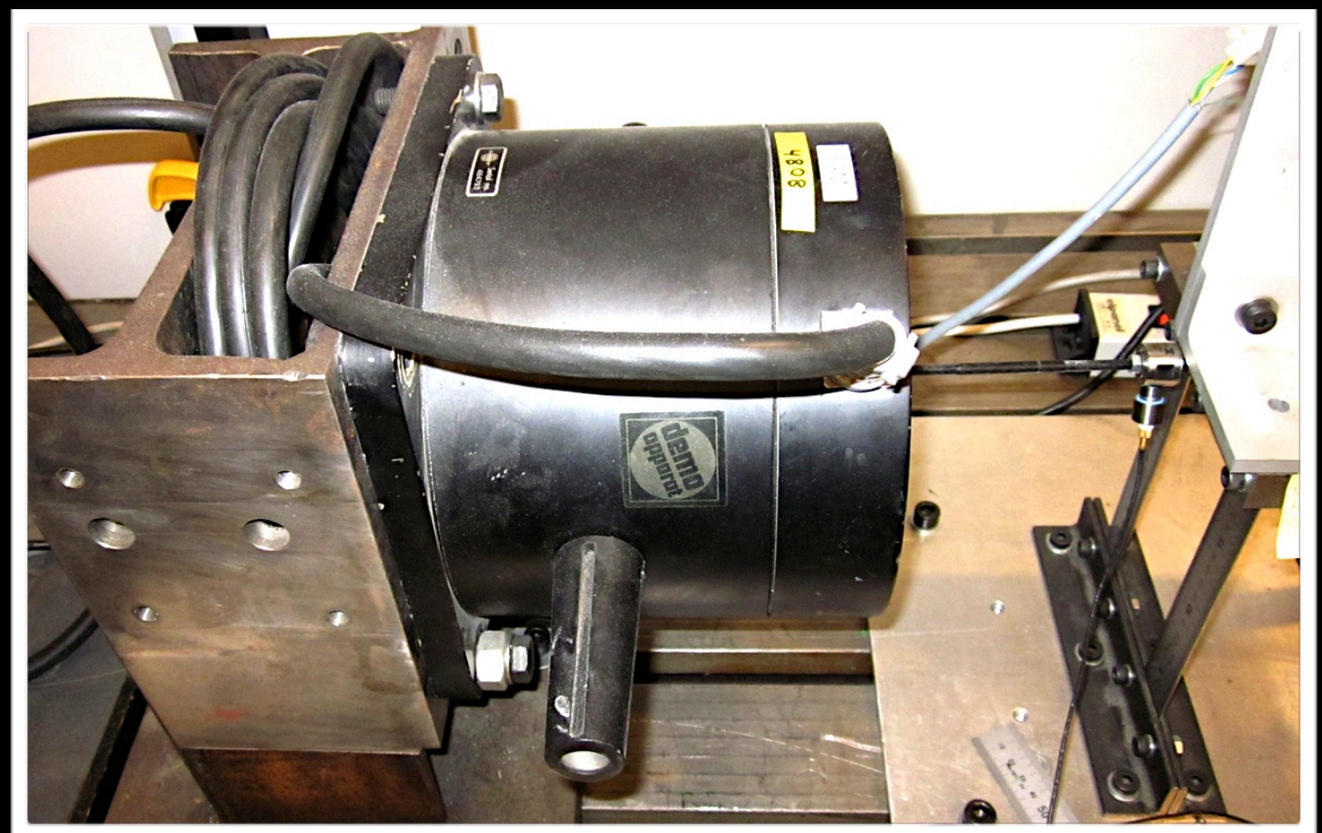
Method

- Systematically explore non-linear dependency on parameters directly on the physical system.
- Non-invasive control.
- Track unstable vibrations.
- Applications for control-based continuation.

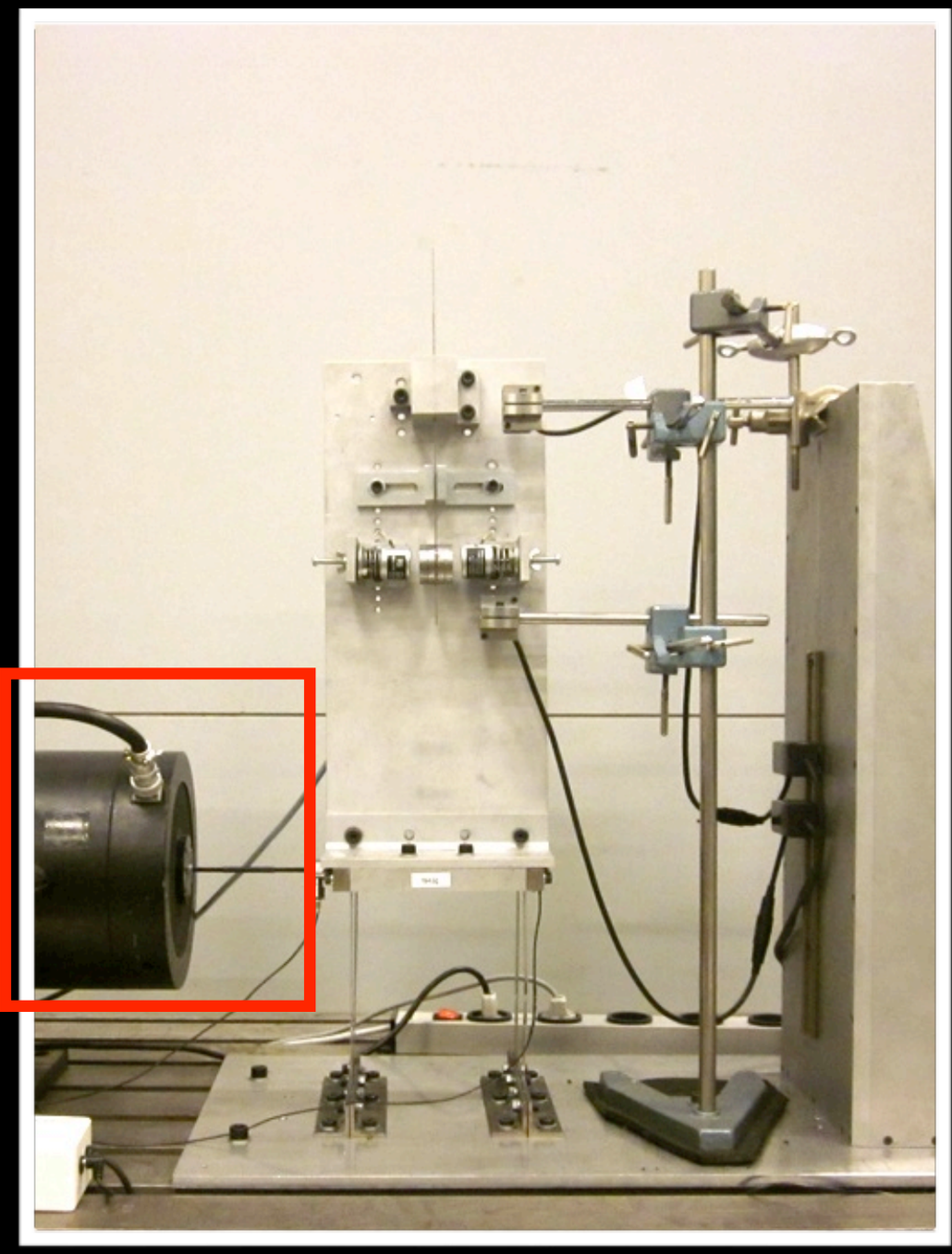
Experimental setup



Experimental setup

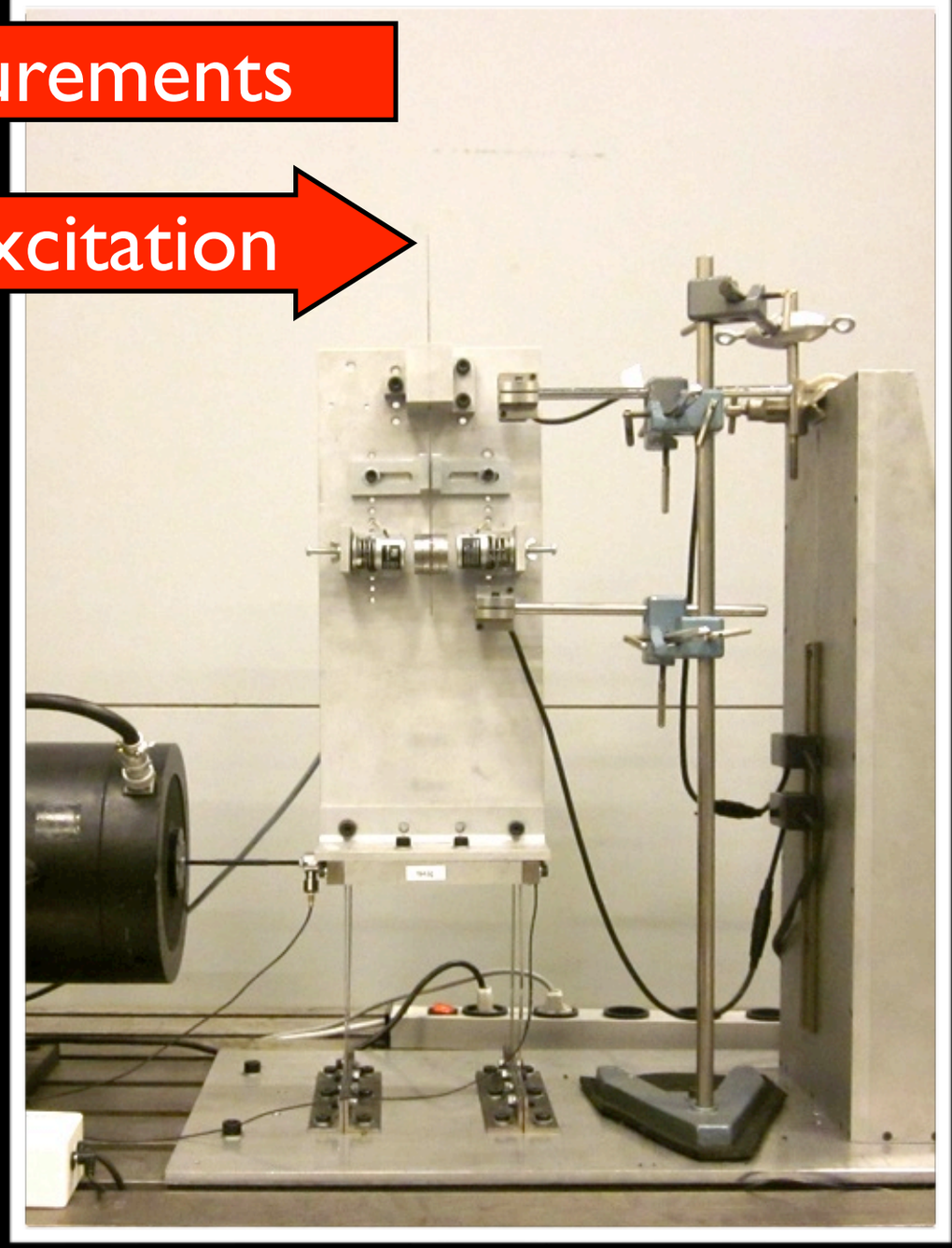


Electromagnetic shaker

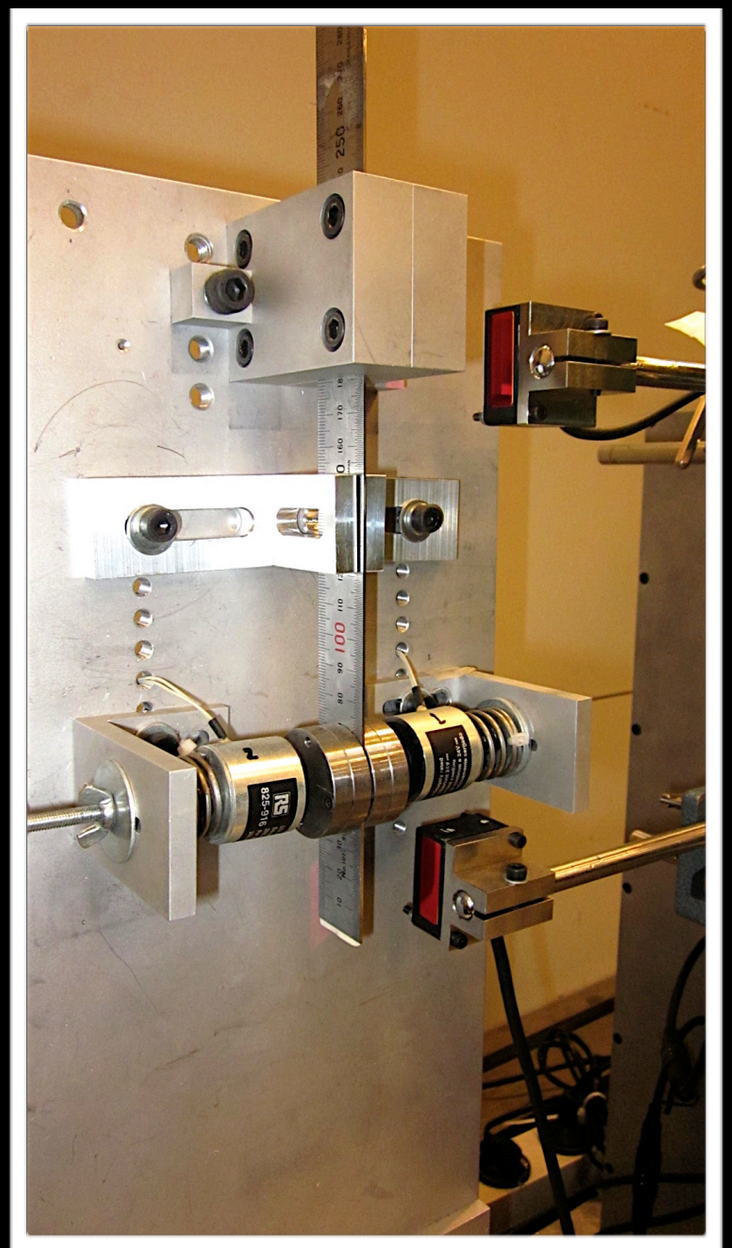


Experimental setup

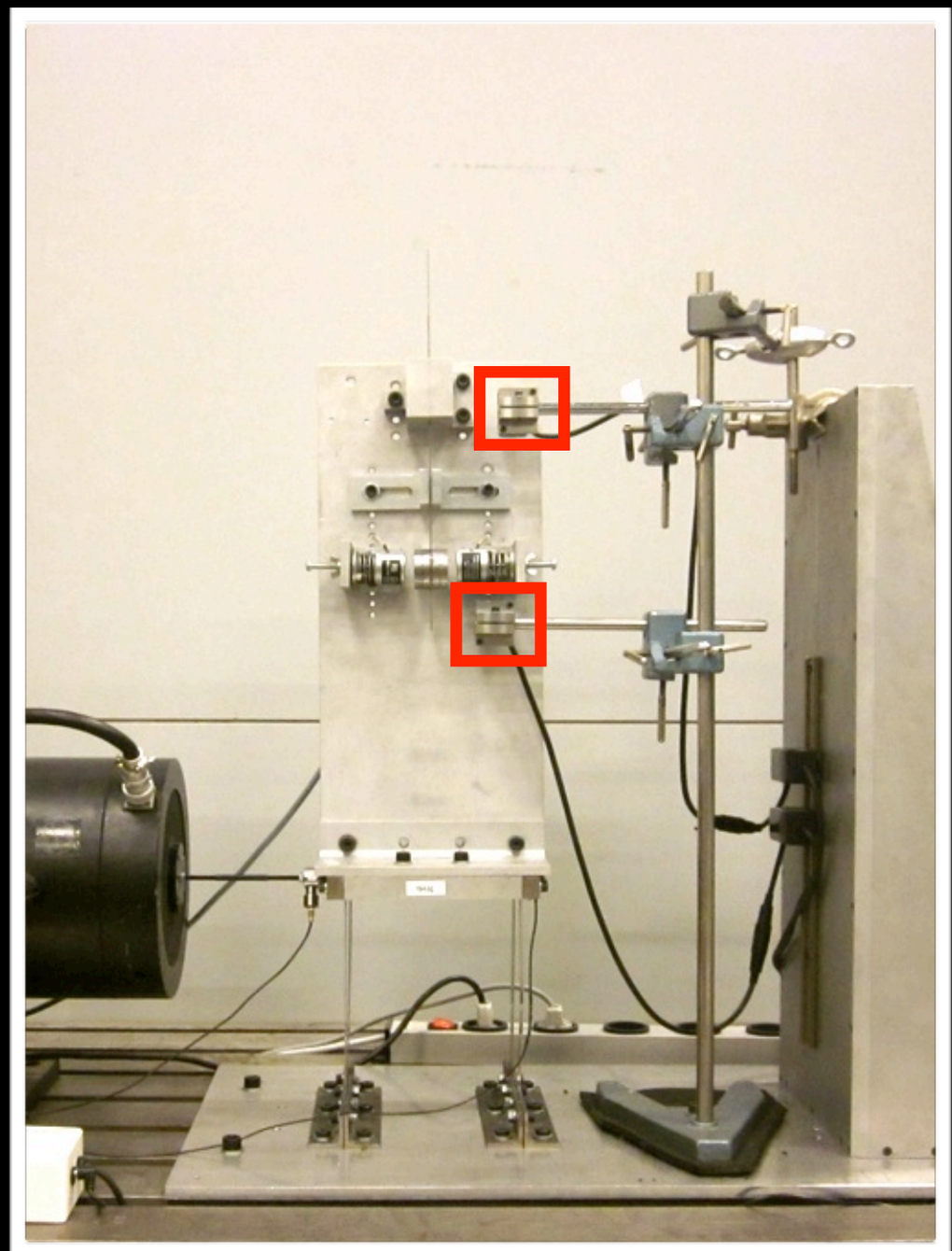
dSpace DS1104 controller board



Experimental setup

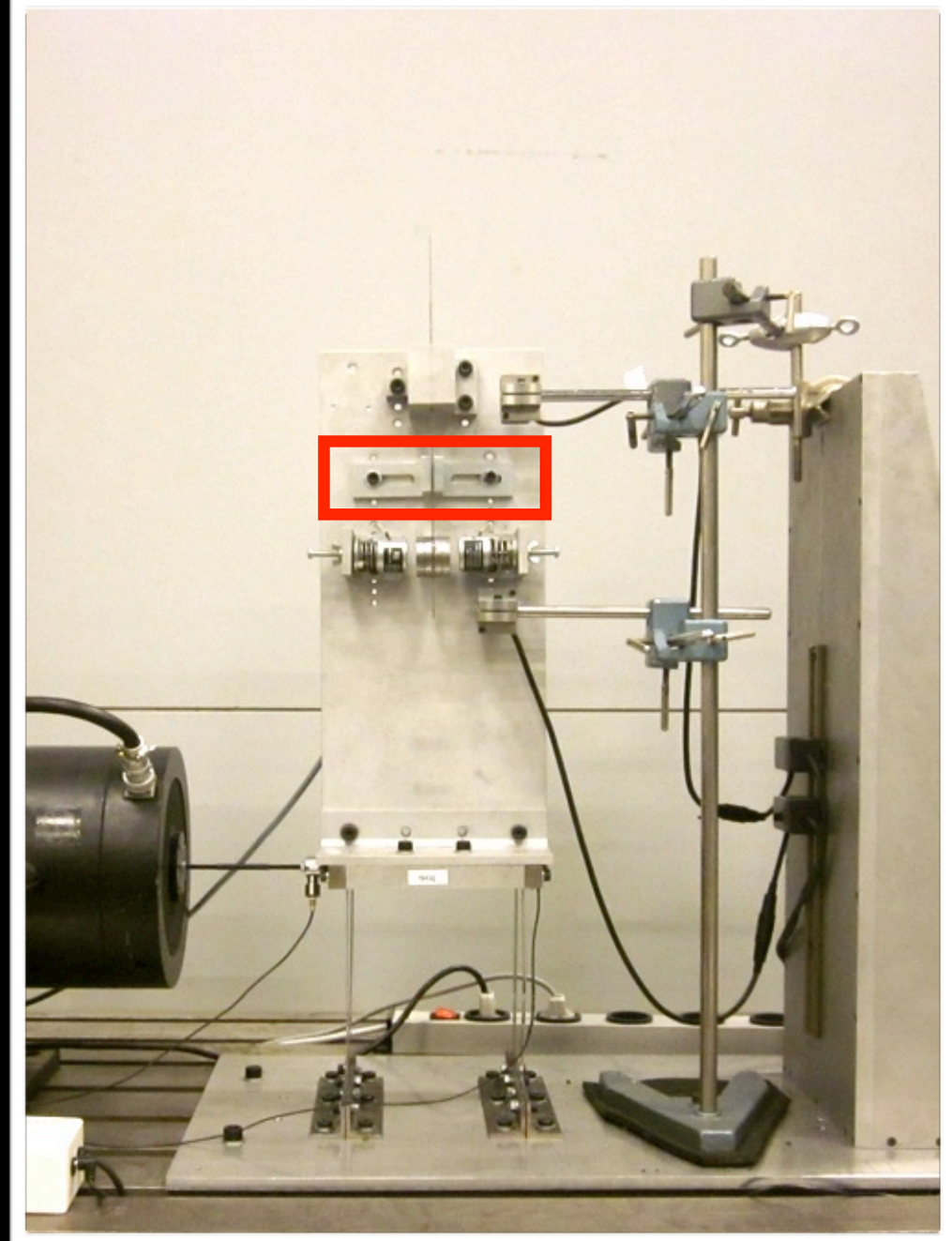


Laser displacement sensors

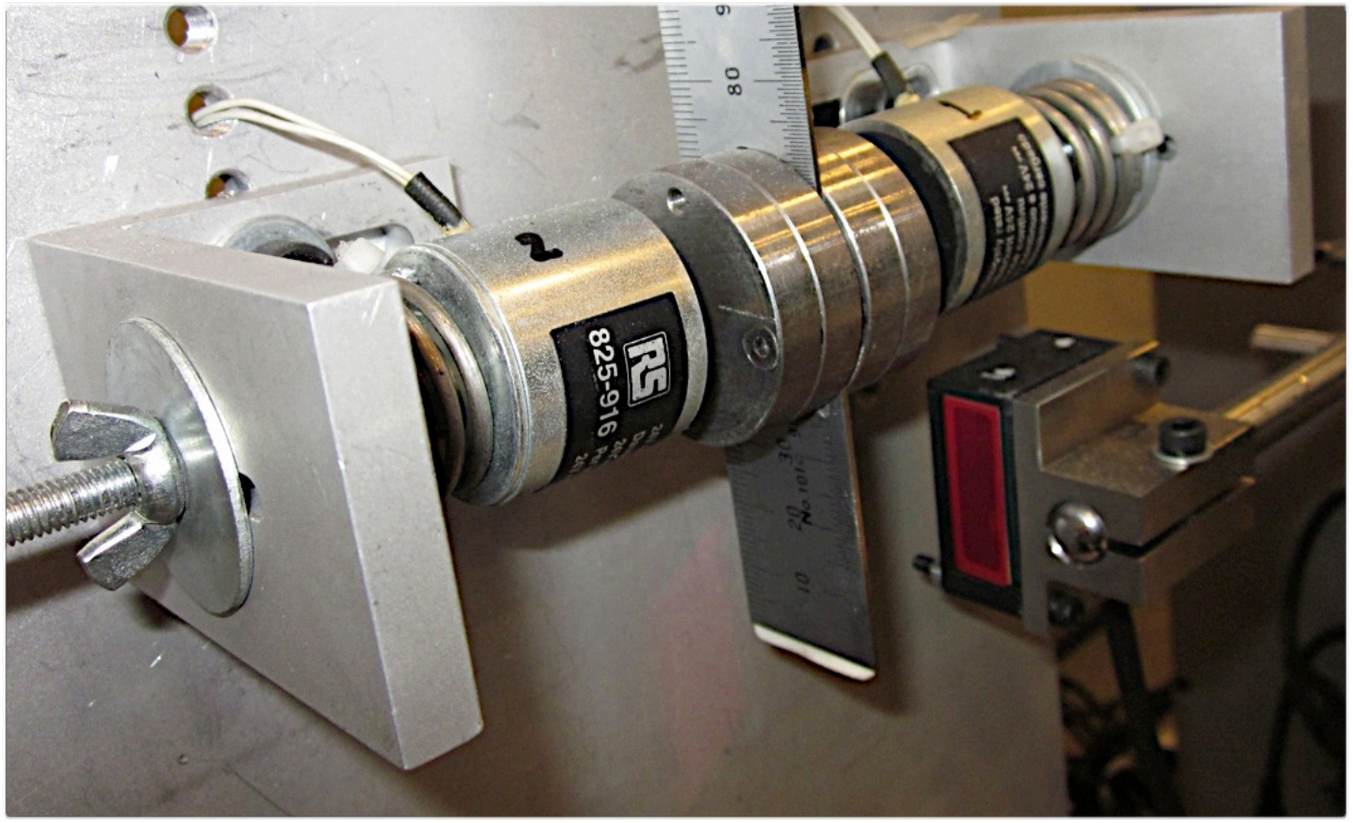


Experimental setup

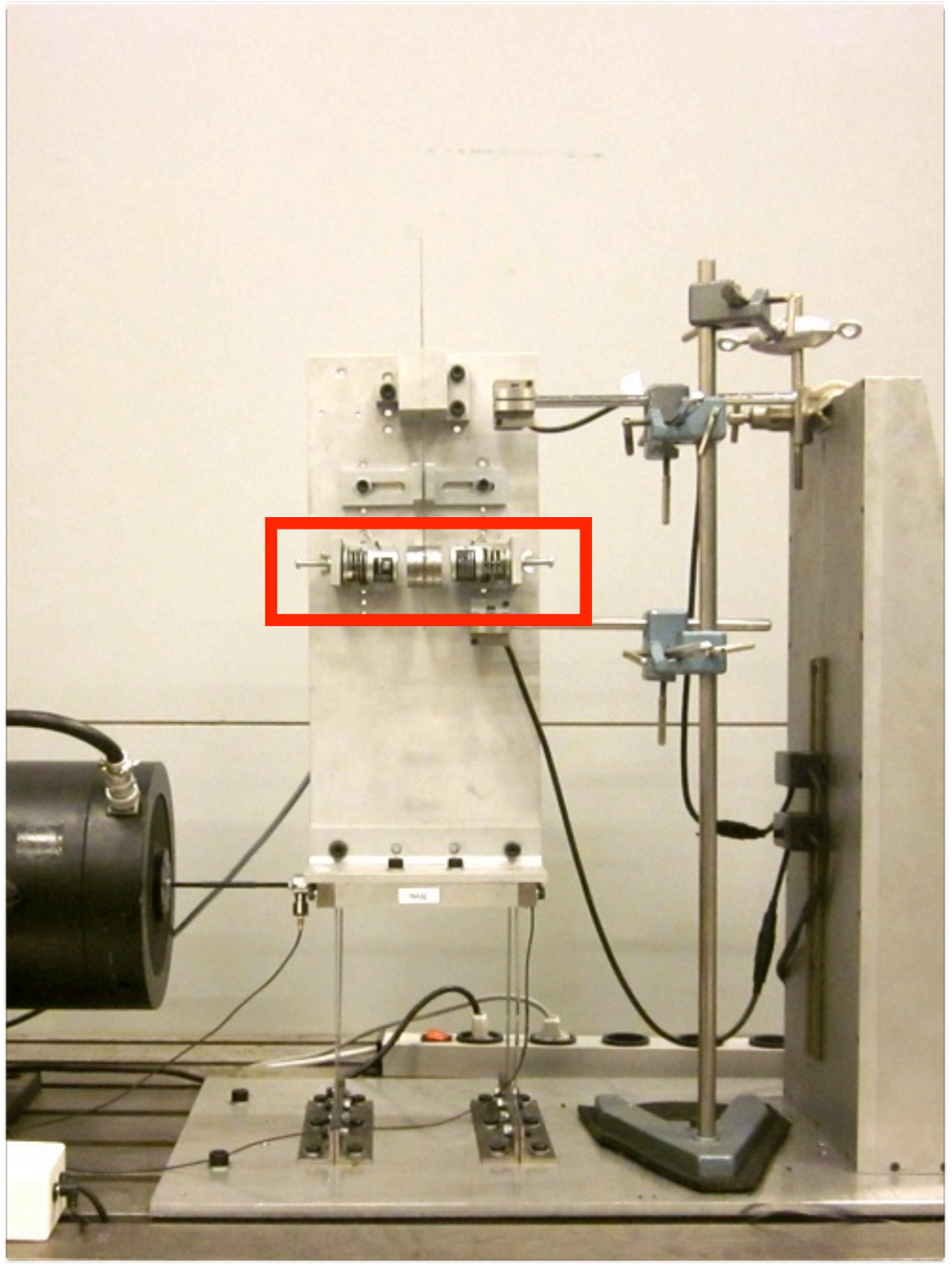
Adjustable mechanical stops



Experimental setup



Electromagnetic actuators



Experimental setup

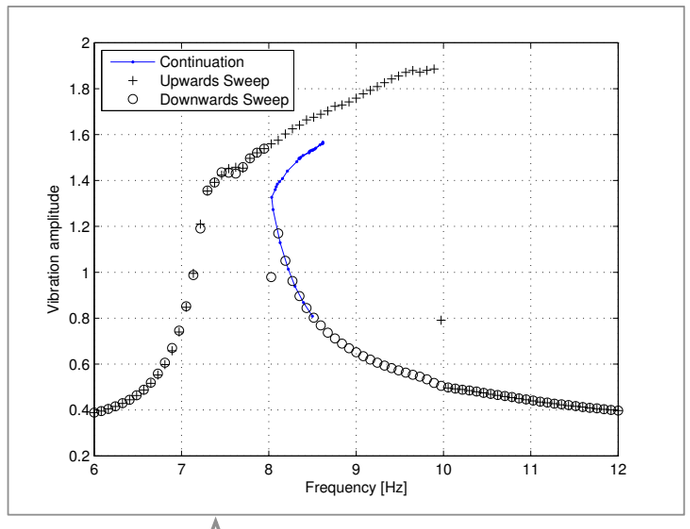
REAL TIME APPLICATION

dSPACE

DS1104 Controller board running the compiled Matlab/Simulink model

- PD-Control
- Signal for vibration-shaker
- Signal filtering
- Fourier Transformation

BIFURCATION DIAGRAM



Control Target provided by Coco (Fourier projection)

PD-Control gains

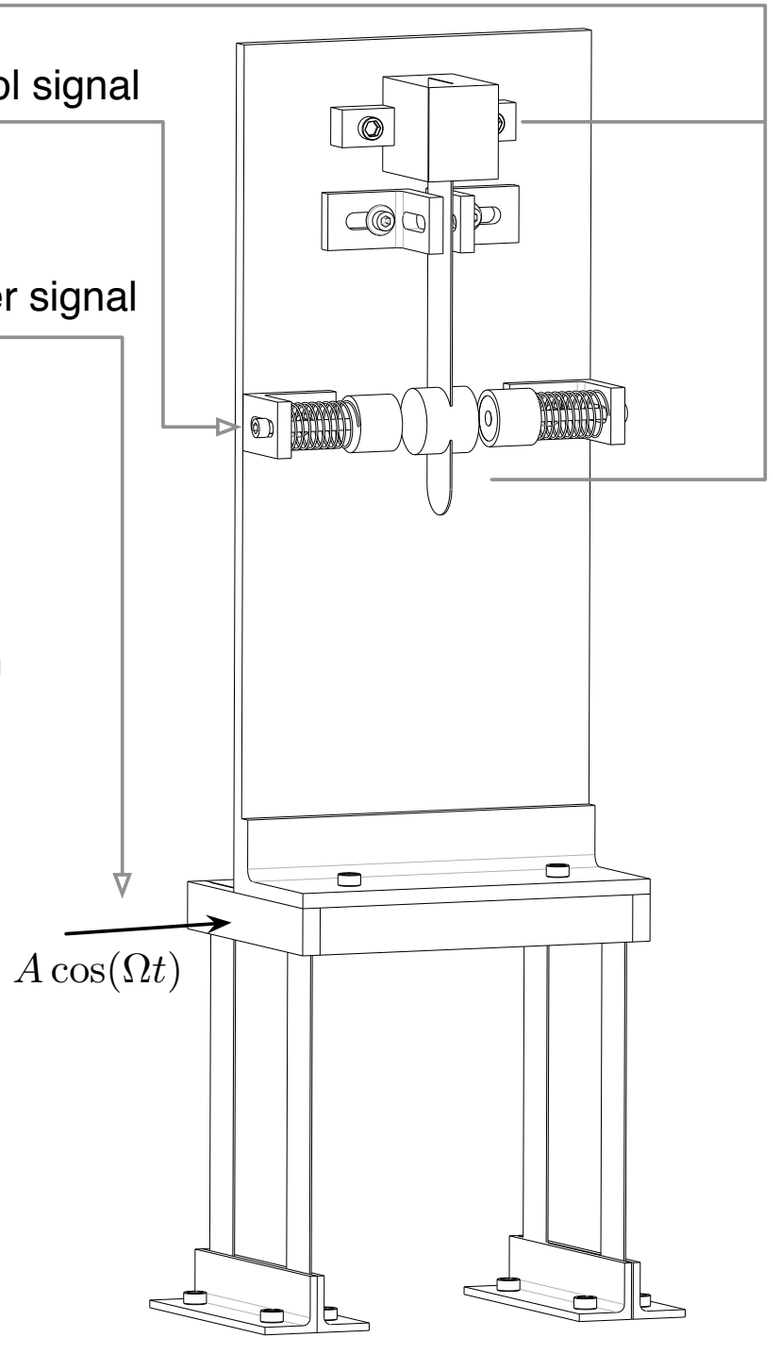
Shaker excitation parameters

Measured relative displacement in time

Control signal

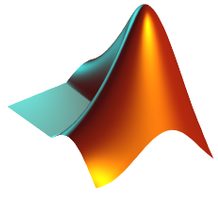
Shaker signal

Measured vibration (Fourier projection)



Accepted steps are plotted

ASYNCRONOUS OFFLINE TASK

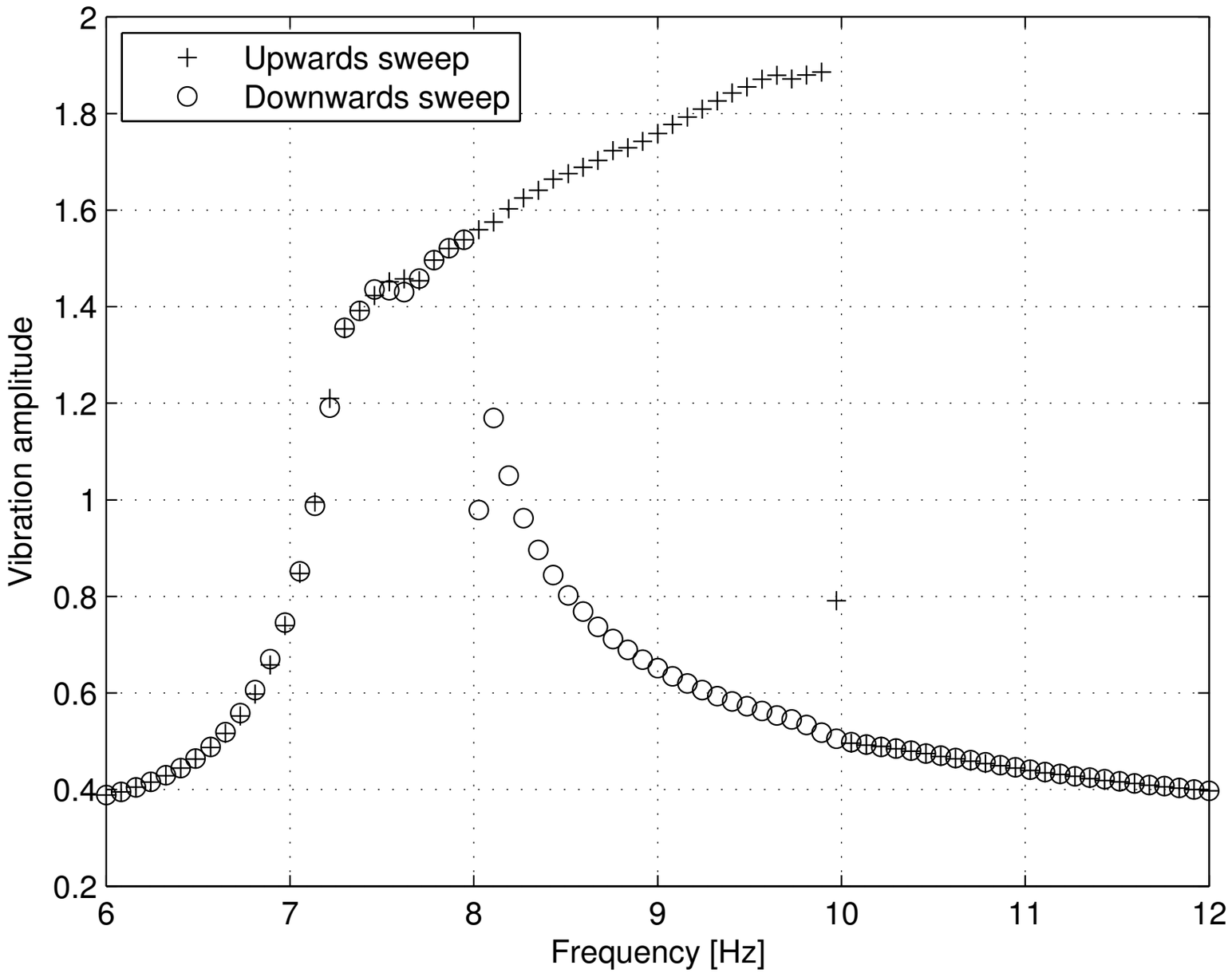


PC Running Matlab and dSpace Controldesk

- Experiment monitoring
- Coco (Continuation Core) & Toolbox

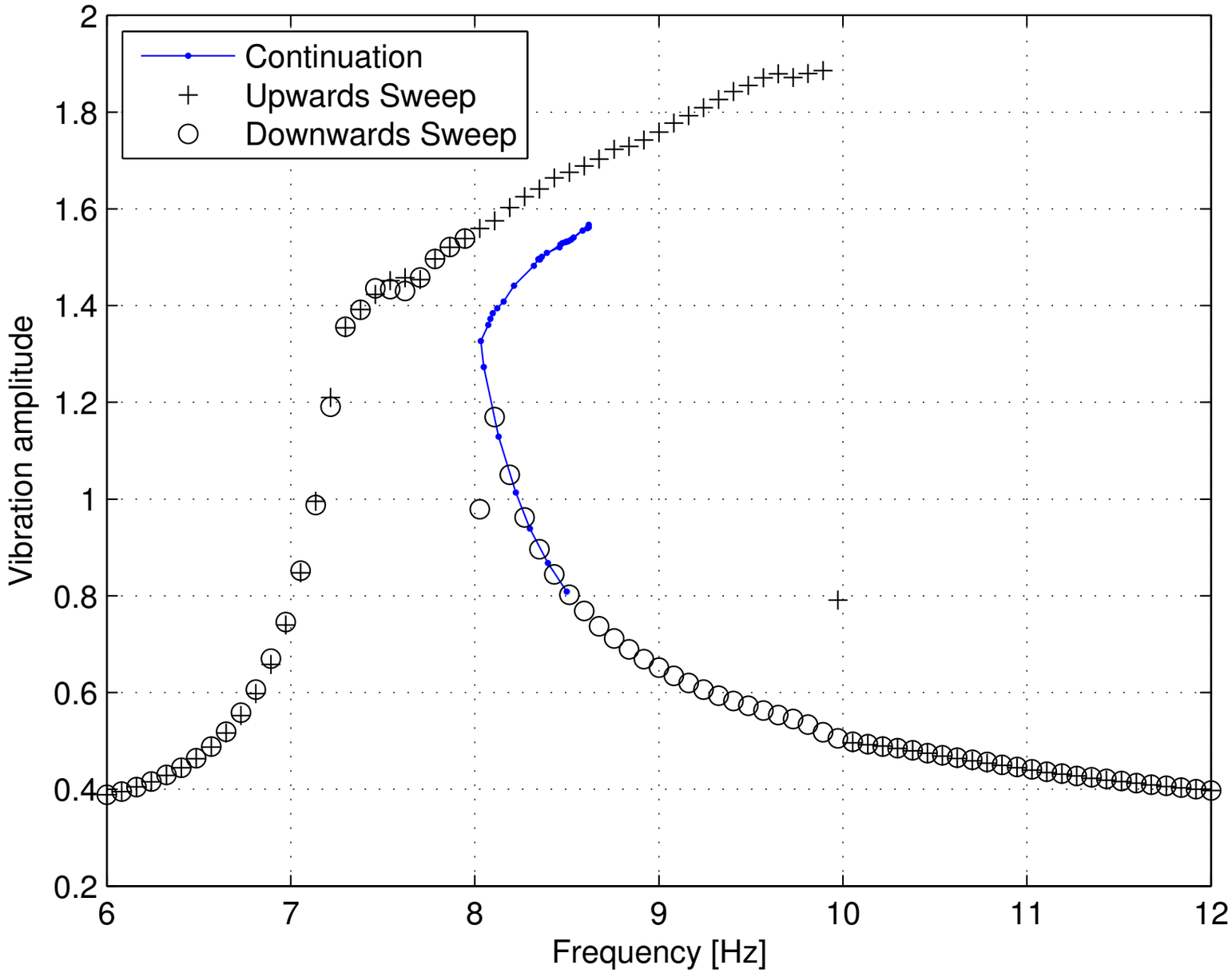
Results

Bifurcation diagram found by frequency sweep



Results

Bifurcation diagram found by control-based continuation



Perspectives

- Extension of the pendulum test rig and toolbox development.
- Rotor dynamics - intelligent machine elements.
- Example: Investigation of bearing properties for foil-bearings.
- Method is applicable in many areas. If the system has a closed control loop, the necessary hardware is already present.

Thank you for your attention!